Matrix Orbital Corporation

VFD2041

User Manual

Important: Read page 2 before applying power.

Connecting VFD2041

Regular Voltage

Power is applied to the white or brown four pin SIP connector as follows:

Pin 1: +5Vdc
Pin 2: = SCL (I²C clock)
Pin 3: = SDA (I²C data)
Pin 4: Gnd

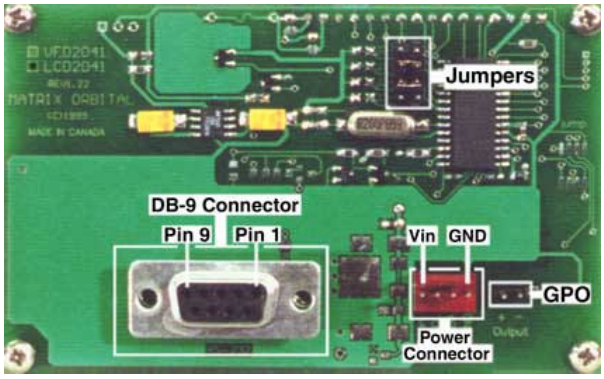
If the sole data source is via the RS-232, the data input is via the DB-9 connector. Pins 2 and 3 are not used.

Wide Voltage Option (V)

Power is applied to the white or brown four pin SIP connector as follows:

Pin 1: +7 - +15Vdc
Pin 2: = SCL (I²C clock)
Pin 3: = SDA (I²C data)
Pin 4: Gnd

If the sole data source is via the RS-232, the data input is via the DB-9 connector. Pins 2 and 3 are not used



WARNING:

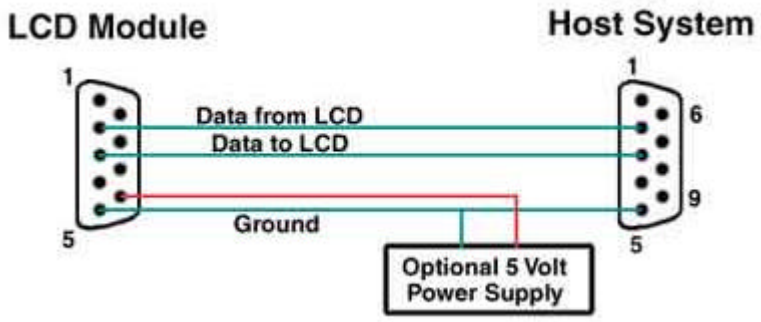
DO NOT APPLY ANY POWER WITH A REVERSED CABLE.
DO NOT APPLY AN VOLTAGE OTHER THAN THE SPECIFIED VOLTAGE.
DO NOT USE ANY CABLES OTHER THAN THE CABLES SUPPLIED BY MATRIX ORBITAL, UNLESS YOU ARE AWARE OF THE MODIFICATIONS REQUIRED.
DO NOT UNDER ANY CIRCUMSTANCES USE AN UNMODIFIED FLOPPY DRIVE POWER CABLE.

DB9 Connector Pin Out

RS - 232 port: This connector is wired so that a standard "straight through" 9 pin D-sub cable may be used to connect the modules on a standard serial port such as comm ports on PCs. Note that this device complies to the EIA232 standard in that it uses signal levels from +/- 3V to +/- 12V. It will not operate correctly at TTL (0 to +5V) levels.

Pin Number	Description
2	Data Out
3	Data In
5	Ground
9	+5Vdc

Note: Signals are shown as interpreted by the Liquid Crystal Display module.



Power may be provided to the module by pin 9 of the DB-9 connector instead of through the 4-pin SIP. If power is to be applied using the DB-9, it must be a regulated +5Vdc supply. If the user intends to use pin 9 as the power source, the user must solder the 5 volt jumper point beside the DB-9 connector. If you have any further questions or concerns don't hesitate to contact Matrix Orbital at support@matrix-orbital.com.

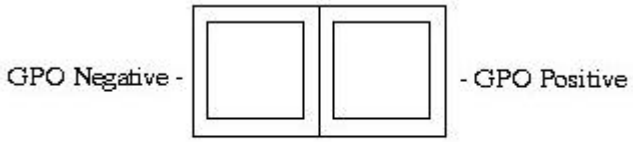
Warning: Use this method of power up at your own risk. Application of a voltage to pin 9 greater than 5.5volts will cause immediate destruction of unit and void the warranty.

Note: This applies to wide voltage units (V and VPT extensions) as well as to standard 5 volt units.

General Purpose Output (GPO)

The GPO is meant to be used as a pair. The positive side of the GPO is connected to a power source of +5Vdc supplied by the module at 20mA. The negative side of the GPO is capable of finding a path to ground through a 240 ohm resistor. This resistor will limit the current flow through a GPO to approximately 20mA in the event of a short circuit. If the device which is being driven by a GPO requires a relatively high current (such as a relay) and has an internal resistance of it's own greater than 250 ohms, then the 240 ohm resistor may be shorted. You will find this resistor directly below the negative pin of the general purpose output.

Note: This operation requires soldering. The GPO does not have any over current or over/under voltage protection so care must be taken if the user decides to connect the negative side differently. For instance if the external device is a relay it must be fully clamped to absorb any generated back electromotive force (EMF).



Configuring VFD2041

Default configuration is J1 and J2 installed. This configures the RS-232 to 19 200 baud and I²C to slave address 0x5C - depending on which connector is used. Please refer to the Appendix of this manual for programming notes.

RS-232 port: J0, J1, J2 - control baud rate
RS-232 format is 8N1 (8 characters, no parity, one stop bit)
I²C port: J0, J1, J2, J3 - sets slave peripheral address

Baud Rate	Slave Address	J3	J2	J1	J0
1200	50H	Off	Off	Off	Off
	52H	Off	Off	Off	On
2400	54H	Off	Off	On	Off
	56H	Off	Off	On	On
9600	58H	Off	On	Off	Off
	5AH	Off	On	Off	On
19200	5CH	Off	On	On	Off
	5EH	Off	On	On	On
1200	60H	On	Off	Off	Off
	62H	On	Off	Off	On
2400	64H	On	Off	On	Off
	66H	On	Off	On	On
9600	68H	On	On	Off	Off
	6AH	On	On	Off	On
19200	6CH	On	On	On	Off
	6EH	On	On	On	On

VFD2041 Command Set

Write Text

This section of the manual allows the user to send commands to the VFD to alter the appearance or behavior of the display. To utilize a command, the user must send a command prefix followed by the command in the format described in this portion of the manual. Any characters sent without a command prefix will be interpreted as text and will be displayed on the module at the current cursor position. The current cursor position will be incremented for each character received. Please note that unless line wrap is turned on, the text will follow the memory map of the module.

The command set discusses in detail what the VFD's capabilities of and how to execute each command. The basic format of all the commands listed in this segment that do not require parameters is:
<command prefix> <command>

For commands that do require parameters however the format is as follows:
<command prefix> <command> [<parameter> <parameter> .....]

Basic Commands

All commands are prefixed by the command 0xFE, Hex FE, Decimal 254

Auto Line Wrap On
ASCII 'C', Hex 43, Decimal 67
Syntax 0xFE 0x43

This command enables the automatic line wrap function. Transmitted characters which overrun the width of the display will automatically wrap to the next line. The bottom line wraps to line 1 of the display. To carry out this command the user must send a command prefix followed the character 'C'.

Auto Line Wrap Off
ASCII 'D', Hex 44, Decimal 68
Syntax 0xFE 0x44

This command disables the automatic line wrapping function. To turn off the the auto line wrapping, send a command prefix followed by the character 'D'.

Auto Scroll On
ASCII 'Q', Hex 51, Decimal 81
Syntax 0xFE 0x51

To turn the automatic line scrolling on, send a command prefix followed by the character 'Q'. In combination with the "Auto Line Wrap" command the text will automatically wrap and scroll up.

Note: "Auto Line Wrap" must be enabled for "Auto Scroll" to work properly.

Auto Scroll Off
ASCII 'R', Hex 52, Decimal 82
Syntax 0xFE 0x82

To turn the automatic line scrolling off, send a command prefix followed by the character 'R'.

Display On
ASCII 'B', Hex 42, Decimal 66
Syntax 0xFE 0x42 < number of minutes >

To turn on the display, send a command prefix followed by the character 'B' and the number of minutes for the display to remain on. If < minutes > is sent as zero then the display will remain on indefinitely. The maximum value for < minutes > is 100. Example:

< command prefix >	0xFE
< command >	0x42
< minutes >	0 to 100

Display Off
ASCII 'F', Hex 46, Decimal 70
Syntax 0xFE 0x46

To turn off the display, send a command prefix followed by the character 'F'.

Clear Display
ASCII 'X', Hex 58, Decimal 88
Syntax 0xFE 0x58

This command clears any text and graphics off the display. To clear the display, send a command prefix followed the character 'X'.

Set Brightness
ASCII 'Y', Hex 59, Decimal 89
Syntax 0xFE 0x89 < hex value defining brightness >

This command sets the level of brightness for the text displayed on the VFD. The level of brightness that can be displayed is from 100% being the brightest and 25% being the dimmest. To execute this command the user must send a command prefix followed by the character 'Y' and a hex value between 0x00 and 0x03 defining the level of brightness. Please note that different lighting conditions and filter will affect the actual value used. Also note that on power up of module the brightness is set to 100% by default.

Hex Values	Brightness
0x00	25%
0x01	50%
0x02	75%
0x03	100%

Cursor On
ASCII 'J', Hex 4A, Decimal 74
Syntax 0xFE 0x4A

To turn the cursor on at the current position, send a command prefix followed by the character 'J'. Note cursor is on by default at power up.

Cursor Off
ASCII 'K', Hex 4B, Decimal 75
Syntax 0xFE 0x4B

To turn the cursor off at the current position , send a command prefix followed by the character 'K'.

Cursor Left
ASCII 'L', Hex 4C, Decimal 76
Syntax 0xFE 0x4C

To move the cursor one space to the left of current position, send a command prefix followed by the character 'L'.

Cursor Right
ASCII 'M', Hex 4D, Decimal 77
Syntax 0xFE 0x4D

To move the cursor one space to the right of the current position, send a command prefix followed by the character 'M'.

Cursor Blink On
ASCII 'S', Hex 53, Decimal 83
Syntax 0xFE 0x53

To turn on the blinking cursor at the current position, send a command prefix followed by the character 'S'. Please note that the blinking cursor is on by default at power up.

Cursor Blink Off
ASCII 'T', Hex 54, Decimal 84
Syntax 0xFE 0x54

To turn off the blinking cursor at the current position send a command prefix followed by the character 'T'.

Set Debounce Time
ASCII 'U', Hex 55, Decimal 85
Syntax 0xFE 0x55 < number to define debounce time >

To set the time between key press and key read, send a command prefix followed by the character 'U' and a number to define the debounce time. All key types with the exception of latched piezo switches will" bounce" for a varying time, depending on their physical characteristics. The default debounce time for the module is about 65mS, which is adequate for most membrane keypads. This time equates to a setting of 8 using this command as there is a debounce time resolution of 8192 microseconds.

Create Custom Character
ASCII 'N', Hex 4E, Decimal 78
Syntax 0xFE 0x4E < character between 0x00 and 0x07 > < 8 bytes >

This command creates a custom character. For the VFD2041 the user can have up to eight custom characters. To execute this command, send a command prefix followed by the character 'N'. The display will now await the number which identifies the custom character. This number must be between 0x00 and 0x07. When the module determines what character it's working on, then the user must send 8 bytes which define the display character. See the diagram below for and explanation of the display character structure.

Diagram A

MSB							LSB	
*	*	*	1	2	3	4	5	Data Byte 1
*	*	*	6	7	8	9	10	Data Byte 2
*	*	*	11	12	13	14	15	Data Byte 3
*	*	*	16	17	18	19	20	Data Byte 4
*	*	*	21	22	23	24	25	Data Byte 5
*	*	*	26	27	28	29	30	Data Byte 6
*	*	*	31	32	33	34	35	Data Byte 7
*	*	*	36	37	38	39	40	Data Byte 8

Pixel Layout of Display Characters

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
Cursor Line				

General Purpose Output On
ASCII ' V', Hex 56, Decimal 86
Syntax 0xFE 0x56 < hex number corresponding to output >

To turn a general output purpose on, send a command prefix followed by the character 'V' and hex number which corresponds to the output which will be turned on. To turn on output five, the sequence would be:

< command prefix >	0xFE
< command >	0x56
< hex number corresponding to output >	05H

General Purpose Output Off
ASCII 'W', Hex 57, Decimal 87
Syntax 0xFE 0x57 < hex number corresponding to output >

To turn a general output purpose off, send a command prefix followed by the character 'W' and a hex number which corresponds to the output which will be turned off.

Go To Position
ASCII 'G', Hex 47, Decimal 71
Syntax 0xFE 0x47 < column number > < row number >

To set the current cursor position, send a command prefix followed by the character 'G' and two values defining the column and row of the desired cursor position.

Go To Top Left
ASCII 'H', Hex 48, Decimal 72
Syntax 0xFE 0x48

This command resets the current cursor position to the top left of the VFD screen. To execute this command send a command prefix followed by character 'H'.

Initialize Large Digits
ASCII 'n', Hex 6E, Decimal 110
Syntax 0xFE 0x6E

Before any large digits may be created, this command must be executed. It only needs to be sent once to initialize the custom characters for large digits. Due to the fact large digits use pre-determined custom characters, no user custom characters may be displayed or created while digits are in use.

Place Large Digit
ASCII '#', Hex 23, Decimal 35
Syntax 0xFE 0x35 <column number> <digit number>

This command allows the creation of large digits on the VFD screen. To execute this command the user must send a command prefix followed by the character '#' and the column number where the digit is to be placed. Then the user must enter the number of the large digit which is required in hexadecimal. Numbers of almost full display height may be placed along side regular text on four row displays. The column number has a maximum value which is less than the display width because the digits are all three columns wide. The module must be initialized for large digit creation before large digits may be placed. If regular text and large digits are mixed on one screen, the user should always set the display cursor position before placing regular text because the creation of a large digit will leave the cursor position to the bottom right of the large digit and not at the last regular text write position. The format for this command is as follows:

<command prefix>	0xFE
<command>	0x23
<column number>	0x01 to 0x12 (1 to 18 for a 20 column display)
<digit number>	0x00 to 0x09 (numbers 0 to 9)

Initialize Horizontal Bar Graph
ASCII 'h', Hex 68, Decimal 104
Syntax 0xFE 0x68

Before any horizontal bar graphs may be created, this command must be executed. It only needs to be sent once to initialize the custom characters for bar graph creation. Due to the fact bar graphs use custom characters, no user custom characters may be displayed or created while bar graphs are in use.

Make Horizontal Bar Graph
ASCII '|', Hex 7C, Decimal 124
Syntax 0xFE 0x7C <column number> <row number> <direction> <bar length>

This command places a horizontal bar graph at the specified column and row with the specified width. The format of the command is as follows:

<command prefix >	0xFE
<command>	0x7C
<column number>	0x01 to 0x14 for a twenty column display
<row number>	0x01 to 0x02 for a two line display
<direction>	0 for left to right, 1 for right to left
<bar length>	0x00 to 0x64 (0 to 100) for a twenty column display

Bar length is in pixel widths. On a twenty column display the maximum bar graph width is one hundred (if the bar graph starts at the edge). This is due to the fact that each of the twenty columns on the display are five pixels wide. The width of the space between columns is not taken into account.

Initialize Thick Vertical Bar Graph
ASCII 'v', Hex 76, Decimal 118
Syntax 0xFE 0x76

Before any thick vertical bar graphs may be created, this command must be executed. It only needs to be sent once to initialize the custom characters required for bar graph creation. Bar graphs use custom characters, therefore no user custom characters may be displayed or created while bar graphs are in use.

Initialize Thin Bar Vertical Graph
ASCII 's', Hex 73, Decimal 115
Syntax 0xFE 0x73

This command is excuted in exactly the same manner as the 'Initialize Thick Bar Graph' command.

Make Vertical Bar Graph
ASCII '=', Hex 3D, Decimal 61
Syntax 0xFE 0x3D <column number> <bar length>

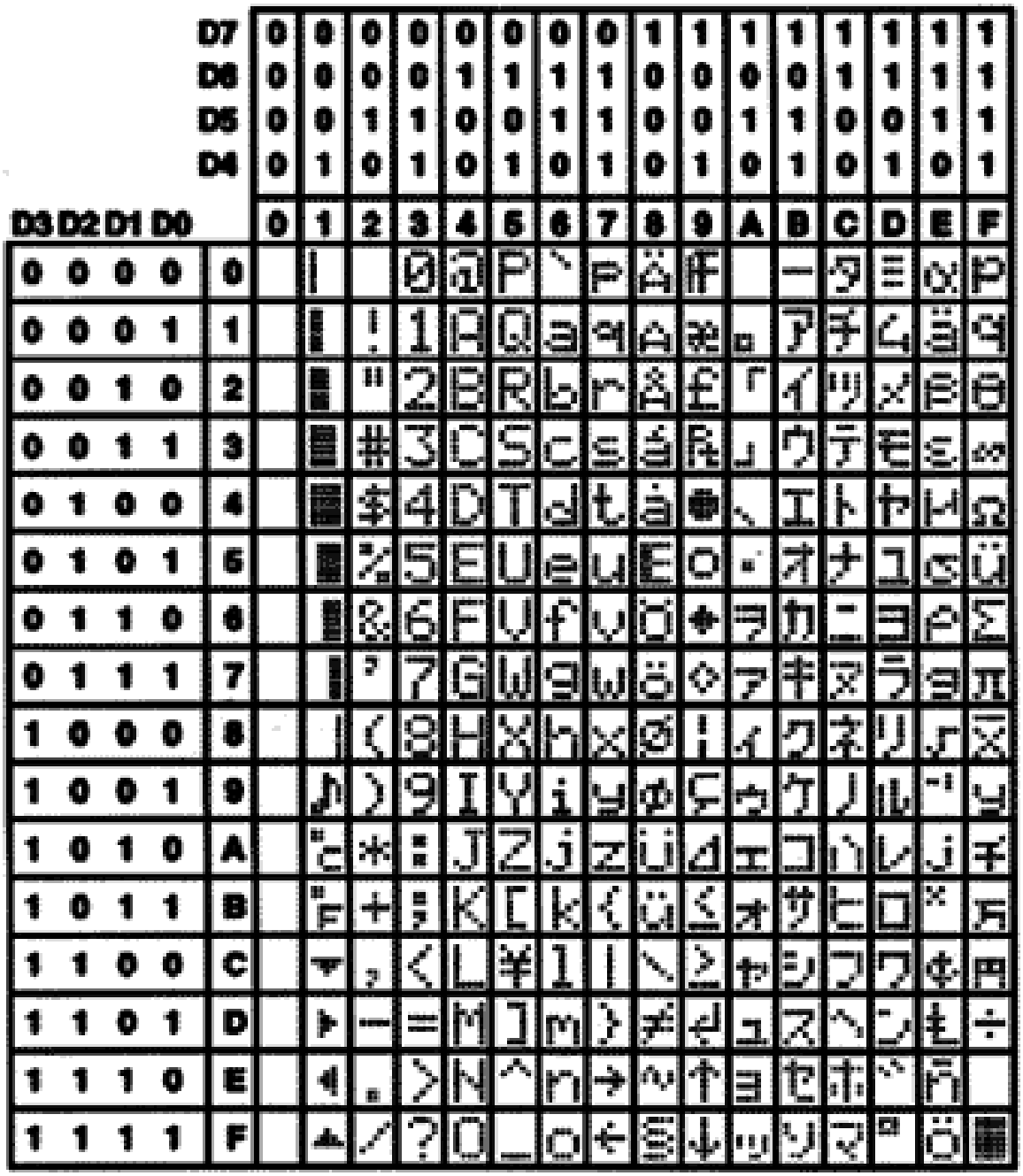
This command places a bar graph at the specified column with the specified height. The style of the vertical bar graph whether it be thick or thin is selected by the initialize vertical bar graph command. If thick bar graphs are preferred, the 'v' command should be send to initialize the bar graph. If a thin vertical bar graph is desired, the 's' command should be sent to initialize the bar graph. The format for the command is as follows:

<command prefix>	0xFE
<command>	0x3D
<column number>	0x01 to 0x14 for an twenty column display
<bar length>	0x00 to 0x20 (1 to 32) for a two line display.

Bar height is in pixel widths. On a two line display the maximum bar graph height is sixteen, this is because each of the lines in the display are eight pixels high. The width of the space between the lines is not taken into account.

Note: Vertical bar graphs may not be used with horizontal bar graphs, and thick bar graphs may not be used with thin bar graphs. This is because all these functions make use of the same "custom character" spaces. As a result, custom characters are also unavailable while any of these functions are in use.

VFD Character Font Chart



Specifications

Environmental Specifications

	Standard Temp.	Extended Temp.
Operating Temperature	-20º to +70º C	-40º to +85º C
Storage Temperature	-40º to +80º C	-50º to +85º C
Operating Relative Humidity	20 - 80% max non-condensing	
Vibration (non-operating)	10 to 55 to 10Hz (Frequency)	
	1.0 mm (Total Amplitudes)	
	30 minutes (Duration)	
	X, Y, Z, each direction	
Shock (non-operating)	539m/S², 10mS	

Electrical Specifications

Supply Voltage	4.75 - 5.25 Vdc (optional 7 - 15Vdc)
Supply Current (all dots on)	275mA typical
Supply Current (display off)	9mA typical
Supply Current (power up)	Up to 550mA inrush

Optical Characteristics

Number of characters	80 (20 Characters x 4 Lines)
Matrix format	5 x 7 with underline
Display area	70.80 x 20.90 mm (XxY)
Character size	2.40 x 4.70 mm (XxY), not including underline
Character pitch	3.60 mm
Line pitch	5.40 mm
Dot size	0.40 x 0.50 mm (XxY)
Dot pitch	0.50 x 0.70 mm (XxY)
Luminance	350cd/m² (100fL) min.
Color of illumination	Bluish Green

Appendix

Important VFD Precautions

All VFD modules contain MOS LSI. Antistatic handling procedures are always required.

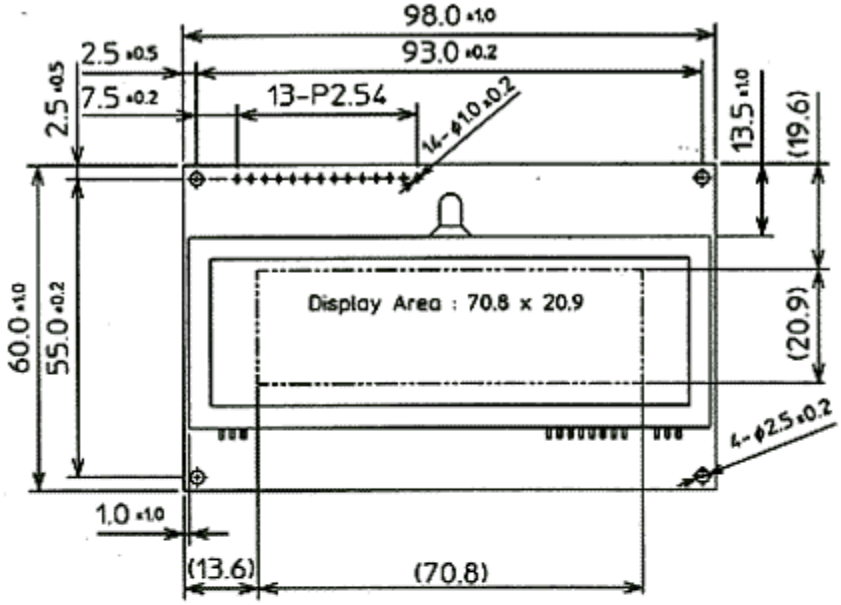
VFD displays consist of Soda-lime glass. Heavy shocks of more than 100G, thermal shock greater than 10°C/minute or a direct hit with hard material to the glass surface - especially to the EXHAUST PIPE - may CRACK the glass.

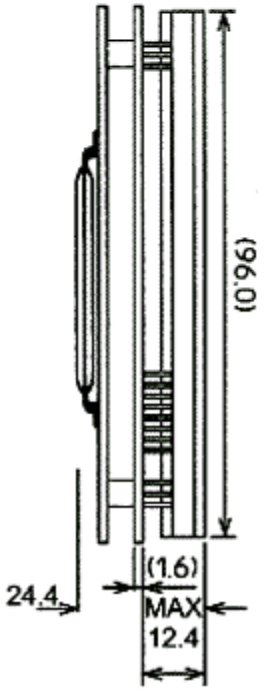
Do not PUSH the display strongly. When mounting to the system frame, a slight gap between the display glass face and front panel is necessary to avoid a contact failure of lead pins of the display. Twisting or warping during mounting will make the glass CRACK around the lead pin of the display.

Do not apply slow-start power. Provide a sufficient output current power source to avoid problems with INRUSH CURRENT at power up. Power supply current capability should be at least equal to the "Supply Current (power up)" as listed in the Electrical Specifications.

Steady repeating of a fixed (static) message display for longer than 5 hours in a day may cause the phosphor to "burn in". An automatic shut down using the timed power down function (display on/off) is recommended.

VFD2041


98.0 ±1.0
93.0 ±0.2
2.5 ±0.5
7.5 ±0.2
2.5 ±0.5
13-P2.54
14-φ1.0 ±0.2
13.5 ±1.0
(19.6)
Display Area : 70.8 x 20.9
(20.9)
60.0 ±1.0
55.0 ±0.2
4-φ2.5 ±0.2
1.0 ±1.0
(13.6)
(70.8)


(0'96)
(1.6)
MAX
12.4
24.4

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Note: Currently only carries LCD2041, LK204-25

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